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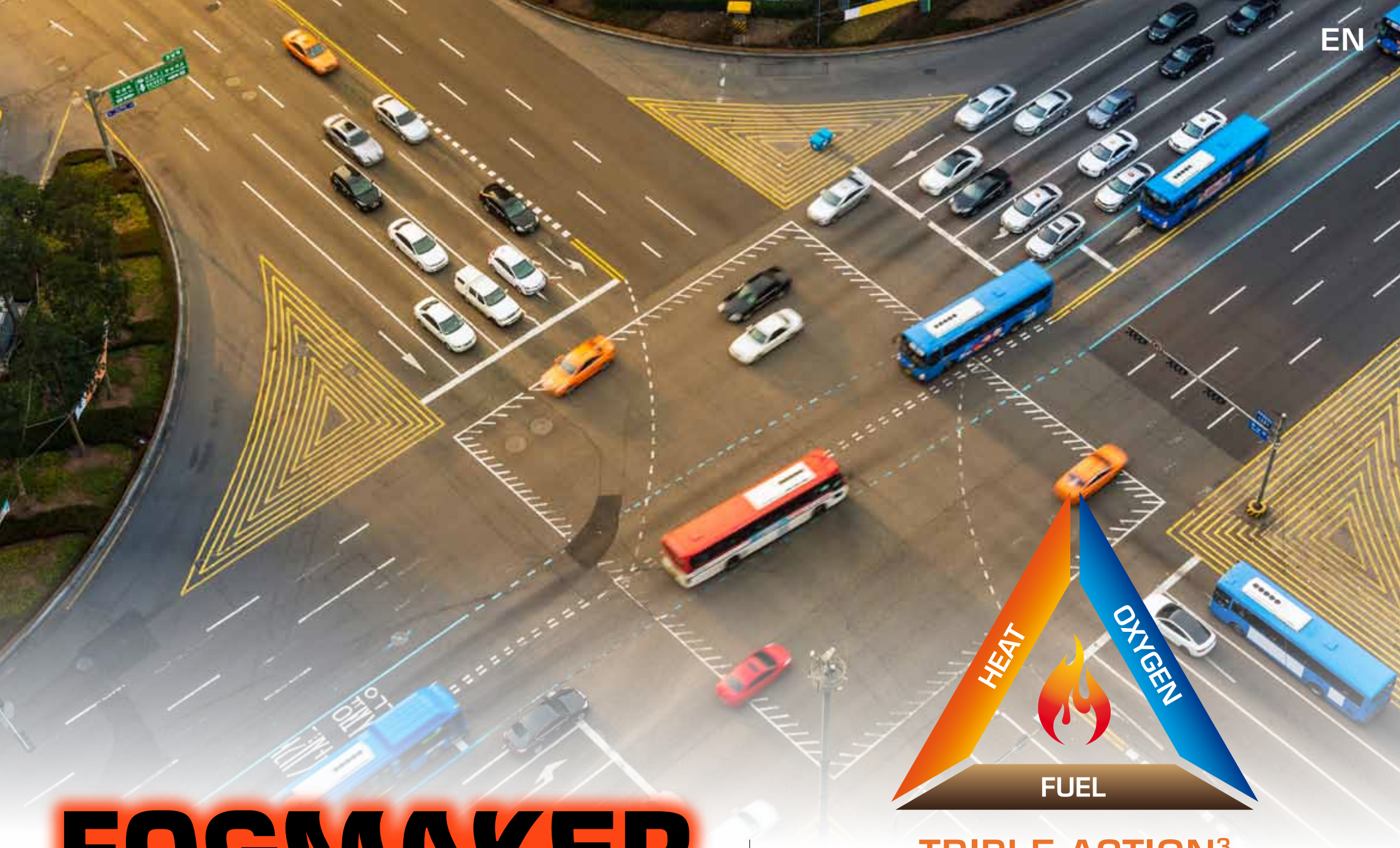


FOGMAKER

Fire suppression for engine compartments

TRIPLE ACTION³

with high pressure water mist

THE CHALLENGE

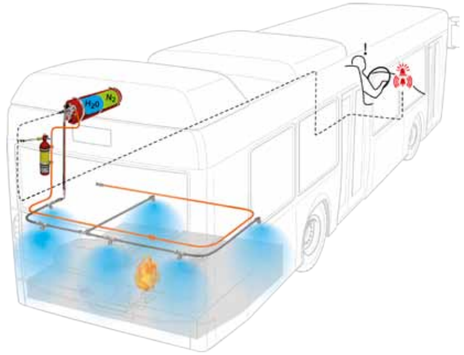
The complexity, dangers and physical aspects of engine fires

It is well-known that the increased demands on reduced emission levels, such as EuroVI and EPA have led to higher fuel pressures and increased temperatures in the engine compartment. In combination with the time-critical industry demands, the risk for fires to start in the engine compartment has risen dramatically.

Statistics show that 40-60% of all fires in buses originate in the engine room. This has been a rising figure over many years. **Electrical failure** is the dominating cause, and **oil or fuel leakage** lead to several fires. Together, these three are the cause of 75% **of all bus fires**[1]

Bus operations are extremely sensitive to unscheduled **downtime**. A bus engine fire can be devastating, as every minute of operation counts. As well as the effect from a bus fire on the surroundings: local residents may have to be evacuated, roads closed resulting in traffic jams, local business' fire alarms may be affected as well. An ignited engine fire could lead to a rapid and **disastrous series of events**. The end result in form of **financial and operational consequences**, in the event that started with e.g. an electric failure or a ruptured hydraulic hose, is something that all bus operators and manufacturers want to prevent.

Still the most important resource of any company is the **human workforce and passengers**, whom is put at great danger, in the event of a fire.



A fire in an unprotected engine compartment is hard to detect and has often a very intense course of event. It is almost impossible to suppress with a portable extinguisher. The safety requirement for automatic fire suppression system in buses exist in many places around the world since several years, and more and more countries, insurance companies and bus manufacturers and operators, are being added to the list.

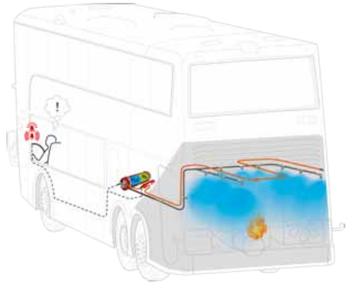
But an important question to keep in mind is what **the physical aspects of a fire** are.

Heat, oxygen and fuel all must be foreseen and attacked. These triple elements of a fire are often symbolized with the fire triangle. Only taking out one corner of the triangle can be sufficient to kill a fire. However the complex nature of a vehicle engine fire does not leave guarantees. Re-ignition, or reflash, of fires occur. Therefore, **a triple action fire suppression system attacking all three elements simultaneously** is the safest and most logic method for minimizing of equipment downtime, business continuity and protecting human lives.

At the same time, the fire suppression system must constantly be ready to act, independent of human interaction, vehicle position and vehicle activity.

These complex circumstances are **all covered by Fogmaker** high pressure water mist technology.

[1] Bussar och Brandsäkerhet Januari 2016 [Buses and fire safety January 2016], Sveriges Bussföretag, www.transportforetagen.se, http://www.transportforetagen.se/Nyheter/2016/Rapport-Hog-brand-sakerhet-for-svenska-bussar/, Stockholm, Sweden, 2016.



WHY FOGMAKER?

- **Triple Action³** – *attacks all three sides of the Fire Triangle*
- **Simplicity** – *no power supply, position independent, low weight, minimal obstruction*
- **Low service cost** – *5 year service, minimum clean-up after actuation*
- **System monitoring** – *Activity, Low pressure and Fire warning*
- **Automatic shut-down** *option*
- **Single cylinder** *sufficient for up to 6.2m³ (R-107)*
- **Product development** *in-house*

FOGMAKER

A Triple Action³ Fire Suppression System

The Fogmaker system uses the most pure kind of extinguishant – water. In combination with the high pressure and a small amount of foam additive, all three components of the chain reaction that causes a fire – heat, oxygen and fuel – are attacked simultaneously.

HEAT - *Cooling*
Cooling is the far-most important factor when breaking the chain reaction, and water is the supreme agent for the purpose. In the evaporation process the water mist cools the burnt gases and hot parts in the engine compartment.

When the liquid runs through the spray nozzles, one normal size droplet of 1 mm diameter becomes as many as 8000 micro-droplets. The droplets will easily evaporate, taking up the energy from the fire and cools the smoke gas temperature of the compartment.

OXYGEN - *Oxygen displacement*
During the evaporation, from one single liter of water, up to 1700 L of steam is generated. This means that from one single 7.5 L Fogmaker extinguisher, up to 12m³ of steam is generated, causing oxygen displacement, and supports the knockdown effect on the fire.

FUEL - *Smothering*
With a small amount of AFFF surfactant, a coat blanket is created, preventing hot surfaces or fuel contact with oxygen. Therefor the fire is also prevented from reigniting. Thus, the Fogmaker suppression agent is from the same source a Triple Action³ Fire Suppression System.

"From 870 °C to 136 °C in 10 seconds!"

Unique cooling effect, temperature reduction of 734°C in 10 seconds!

Fire suppression test in a simulated engine compartment with a volume of 2,5 m³. The fire source consists of four 20 x 40 cm trays filled with diesel. Diesel spray is also applied at a rate of 2 liters per minute at a pressure of 5 bar, which showers the engine. The heat effect reaches approximately 1,600kW. The pictures are taken with 2 sec intervals. During the whole interval, 10 seconds, approximately 5 dl extinguishant is used.

TRIPLE ACTION³

All three components in the fire triangle are attacked with the FOGMAKER fire suppression system

	HEAT	OXYGEN	FUEL
Triple application	*Evaporation*	*Steam*	*AFFF*
Triple effect	*Cooling*	*Inert gas*	*Smothering*
Triple protection	*Thermal barrier*	*Vapor containment*	*Reduced reflash*

A proven fire suppression solution

Fogmaker is holder of several qualified certifications and approvals. **We are the first ever fire suppression system approved for UNECE Reg. 107 (Europe).** Fogmaker also hold the AS-5062 (Australia), SBF-128 (Scandinavia), is UL listed (UL 1384) and FM pending (FM 5970). Through our processes, we ensure to keep highest possible standards and develop our products. Further following the latest ISO 9001:2015 and 14001:2015, with an ISO-TS 16949 pending, our organization structure is allowed to grow with strength.

This lays a solid ground for our extended organization through our global network of distributors and partners, offering full service wherever our customers are. Today we are covering more than 55 countries in Europe, North & South America, Africa, the Middle East, Asia and Australia.

But first and foremost we are proud over the trust our customers around the world have given us. The Fogmaker fire suppression system first saw daylight in 1995. Today, more than 130 000 vehicles are equipped with Fogmaker High Pressure Water Mist.

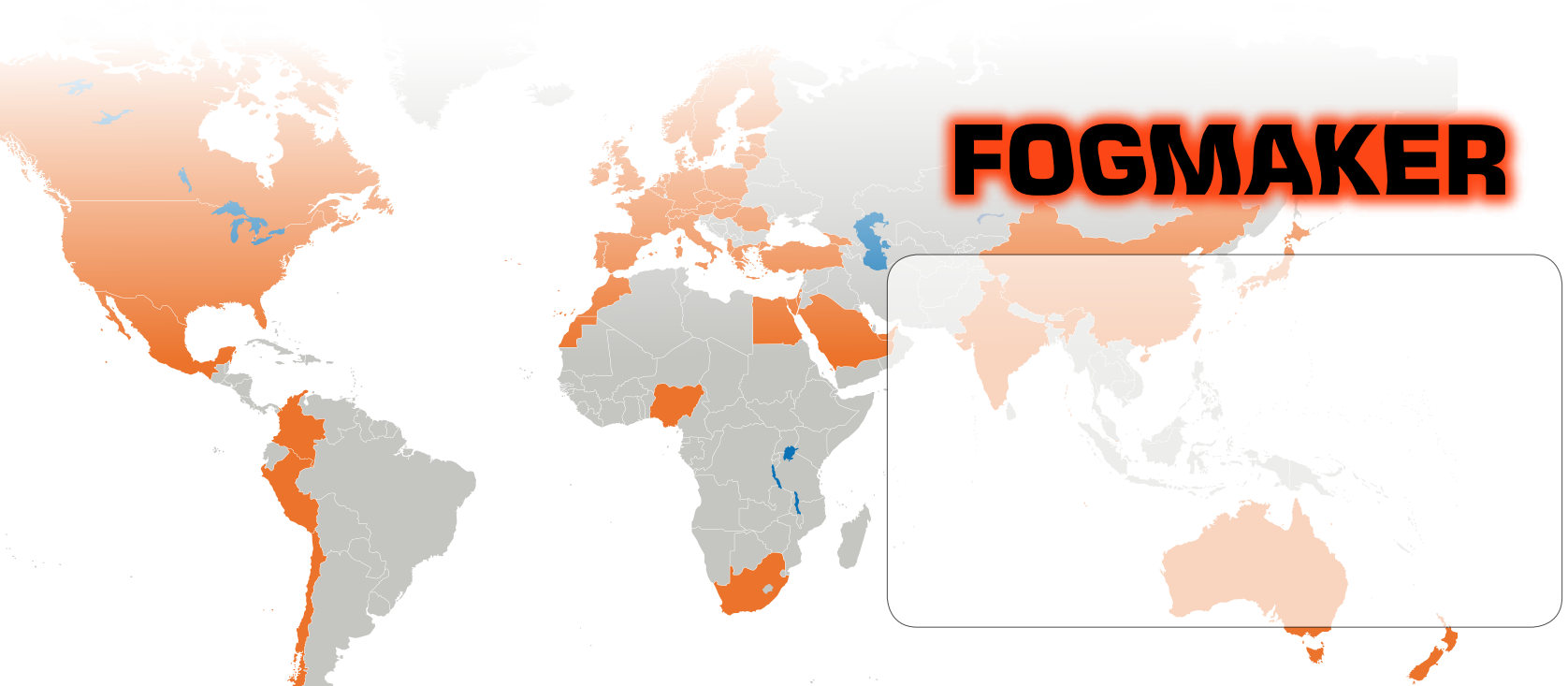
Fogmaker - first fire suppression system to pass official tests for R107!

New European regulation for fire suppression systems in buses:

Fogmaker is already present, except in Sweden, in large cities such as Berlin, London, Washington D.C., Sydney, Istanbul, Hong Kong and Singapore. But now possibilities open for an even wider spread of Fogmaker's technology to protect vehicles, capital, and especially human life.

From July 11th, 2019, all new coaches and double decker buses across the European Union will have a permanently installed fire suppression system in the engine compartment. From September 2021, this regulation also applies to road and city buses. This framework falls under UNECE R-107, and the requirements for this type of fire suppression systems are based on a test method developed by SP in Sweden.

The fire suppression systems are tested in a rig built to mimic a real bus engine bay, with different fire sources and with different circumstances such as varying fan speed. Fogmaker was the first fire suppression manufacturer to carry out the official tests with successful results.



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UNECE R-107
United Nation Economic Commission for Europe

AS-5062
Australian Standard

UL-1384 (UL listed)
Underwriter´s Laboratories

SBF-128
Swedish Fire Defense Ass.

...and FM-5970 pending!
Factory Mutual

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